that conserve and prize at their proper value their priceless treasures of carbon.

Allerton S. Cushman,
Assistant Director
Office of Public Roads,
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MAGNETIC ROCKS

While in southern Arkansas recently, studying the northern outcrops of the oil-bearing horizons of Louisiana, I took occasion to ascertain whether the peridotite eruptives about Murfreesboro, Arkansas, were as magnetic as similar rocks in central New York. They prove to be so; hence it seems that if a somewhat detailed magnetic survey of the region thereabout were made the tens of thousands of dollars now expended in worthless options might practically all be saved. Naturally in searching for diamonds the first information desired is the whereabouts of the volcanic necks bearing the diamond dirt. Though these are covered by plateau gravel or alluvial sands and clays they can be detected as readily as the dikes in central New York can be located though under many feet of glacial till.

G. D. Harris,
Geologist to Louisiana

A NEW PHENOMENON IN ELECTRIC DISCHARGE

During last May the writer used a wire of platinum having a diameter of 0.005 cm., in some work in electric discharge around a right angle in a wire. The discharges were made non-oscillatory in character, by introducing into the circuit a couple of strips of cloth such as is used for surgical bandages. These strips, which were in multiple, connected two tumblers containing salt solution, one of which was about 20 cm. above the other.

During about three weeks of use, a system of wavelets formed along the whole length of the wire. They were very uniform in dimensions. The wave-length was 0.090 cm., and the amplitude from crest to crest was 0.015 cm. The wire was under tension of four grams weight, by means of silk threads passing over pulleys.

The writer is under the impression that the irregular bending of wires traversed by a continuous current has been observed, but is unable to find a reference to it.

Francis E. Nipher

THE DATING OF PUBLICATIONS

To the Editor of Science: Through accident or policy, the Carnegie Institution has not dated many of its recent publications. In bibliographical citations, where dates are used to designate publications, it is difficult to dispose of papers where the time of publication is not given. Moreover, is it not desirable to date articles, to protect the writers in priority?

Max Morse
The College of the City of New York,
February 2, 1909

SCIENTIFIC BOOKS

Die Metamorphose der Insekten. Von P. Deegener. Pp. 56. Leipzig u. Berlin, B. G. Teubner. 1909.

This little book, by one who has written several valuable articles on the development of the alimentary tract of insects, is one of the most thoughtful and suggestive of a number of recent general accounts of Hexapod metamorphosis. The author adopts the now usually accepted view, advanced by Fritz Müller in 1864, that the larvæ and pupæ of insects represent cœnogenetic adaptations, the result of a tendency, so to speak, on the part of an originally monomorphic form, to become strongly trimorphic during its ontogeny. In other words, the more specialized insects (Holometabola) have found it increasingly advantageous to assume three successive forms during their metembryonic development: the first, or larva, being devoted to alimentation and growth, and often exhibiting peculiar modifications to suit the highly specialized environment in which it lives, the third, or imago, being devoted to the reproduction and dissemination of the species, and the second, or pupa, providing for the transformation necessitated by the two other very different stages.

Deegener's work is divided into three parts: an analysis of the organization of the larva, a consideration of the phylogeny of metamorphosis and of the significance of the pupal stage. He recognizes three kinds of larvæ:

the *imaginiform,* which occurs in the Ametabola (Heteroptera, Orthoptera) and is very similar to the imago into which it develops, the *semimaginiform,* which occurs in the Hemimetabola (Amphibiotica, some Homoptera) and is less similar to the adult, and the *true larva* of the Holometabola (Hymenoptera, Diptera, Coleoptera, Lepidoptera, etc.), which is succeeded by a quiescent pupal stage. The organs of the various larvæ are considered under the following heads:

1. Larval organs that are simpler than those of the imago but of nearly the same structure, or such as are absent in the imago but are nevertheless of a primitive character, as shown by comparison with their homologues in lower insects. Examples of such organs are the mouth-parts and antennæ of ephemerid larvæ, the cerci of campodeiform larvæ, non-pentameric tarsi, etc.

2. Organs that are more or less atrophied or vestigial in both larva and imago, *e. g.,* the labium and maxillæ of *Corethra* and *Chironomus,* the larval eyes of *Corethra,* etc.

3. Organs that were first acquired by the imago but subsequently transmitted to the larva, or that have taken on the imaginal form secondarily in the larva, like the sucking mouth-parts of the Hemiptera. To this category Deegener also assigns organs which appear in the larva as primordia of imaginal structures. These he calls *secondary imaginal discs,* in contradistinction to the *primary imaginal discs* which are represented by such structures as the wing-pads of the imaginiform and semimaginiform larvæ.

4. Organs that have been acquired by the larva independently of the imago and are either completely lacking in the latter (pedes spurii, sericteries) or have been acquired by it secondarily (external gills of some Perlids, rectal gills of Odonata, etc.). Such structures are designated as *provisional organs of the first order.*

5. Organs common to both larva and imago but developing in different directions in the two instars (sucking mandibles of the larval *Hemerobius, Chrysopa* and *Dytiscus;* digging legs of *Cicada* larvæ). Such structures are called *provisional organs of the second order.*

6. Organs that are typical or primitive portions of the insect organization but are completely retarded in their development during larval life and remain as primordia, or imaginal discs. These are called *tertiary imaginal discs* to distinguish them from the primary and secondary imaginal discs mentioned under (3). The gonads and their ducts, especially the latter, may be included under this sixth category, but in one sense they form a category by themselves, as they are not specifically insect organs and as the gonads sometimes mature during larval or pupal life.

Deegener calls attention to the fact that none of the organs of the imago is actually lacking in the larva, but that the latter may possess organs which do not occur in the imago. He concludes from this that the true larva "must be derived from the imago and hence presupposes the existence of the imago, and that therefore this is phylogenetically older than the larva, but that the true larva is younger phylogenetically than the imaginiform young of the Epimorpha and semimaginiform young of the Hemimetabola." This conclusion and Deegener's classification of larval characters would appear in a somewhat clearer light had he not neglected to take the embryo into consideration. A single example will make this statement clear. It is well known that certain embryonic organs, such as the thoracic appendages and antennæ, are lacking, as appendages, in the vermiform, or apod larvæ of many Hymenoptera, Diptera and Coleoptera, but are present again in the imago. This fact alone proves that the vermiform larva is an extreme cœnogenetic adaptation. It also throws light on another matter which Deegener, Heymons, Berlese and a host of other writers seem not to have clearly grasped, namely, the significance of the relations of the abdominal appendages of the embryo insect to the so-called prolegs (pedes spurii) of the larva. Deegener says of these:

> I assume that the pedes spurii do not arise directly by transformation from the appendages of polypod ancestors, and hence that they are not phylogenetic recapitulations (any more than are the tracheal gills) but are to be regarded as new

formations, which, however, have not originated independently of the vestiges of the abdominal appendages. The looseness of this dependence, however, is shown in certain Noctuid caterpillars, in which some of the pairs of prolegs make their appearance during larval life and hence at a time when the abdominal appendages have completely disappeared. I can not, therefore, regard the pedes spurii as primary, or even as resuscitated organs, but only as secondarily adapted provisional organs.

This statement if applied to the ontogeny would involve the unwarrantable assumption that the abdominal legs of the embryo disappear in the larva. This they do in many cases as hollow ectodermal evaginations filled with mesoderm, but they persist, nevertheless, as small, flat cellular areas in the ectoderm. In other cases, there is abundant evidence to show that they are directly transformed into the prolegs of the larva (Lepidoptera) and the gonapophyses of the larva or imago (Orthoptera). Where they are not thus transformed directly, but first flatten out, we obviously have the primordia of imaginal discs, and the organs would belong to Deegener's sixth category. Reverting now to the absence of antennæ and thoracic appendages in apod larvæ and their presence in the preceding or embryonic and the succeeding or imaginal instars, we see that we have a case of precisely the same nature as that of the abdominal appendages, though clearer on account of the larger size of the cephalic and thoracic structures and their imaginal discs. But any such ontogenetic conclusion as Deegener draws from the abdominal appendages of the Noctuid larvæ would here land us in the absurdity of supposing that the imaginal antennæ and thoracic legs of such insects as bees, weevils and ants are not completely homologous with their embryonic antennæ and thoracic legs. We are bound to conclude that all insect embryos are polypod and that the most ancient known Pterygogenea, the Palæodictyoptera, as Handlirsch has shown, had well-developed abdominal appendages, which must have been ambulatory in the more remote ancestors. It is, therefore, simpler to suppose, even if embryology did not furnish a great amount of evidence in support of this conclusion, that the ambulatory function has been revived in some of these appendages (pedes spurii of the caterpillars of Tenthredinidæ, Lepidoptera and Panorpatæ, pedes scansorii of Dipteran and Coleopteran larvæ), while others have become portions of the ovipositor and sting of the female insects, than to suppose that these various organs have come into existence *de novo* through modification of abdominal sclerites. This view, which is now fashionable in Germany, has arisen through ignoring or misinterpreting the conditions in the insect embryo, attaching undue importance to supposed homologies of the sclerites of adult insects and supposing that the organization of the Pterygogenea is to be interpreted by means of the Thysanura. It is a pleasure to see that Deegener departs from the conventional view to the extent of regarding the so-called campodeiform larva in the Holometabola as a secondary and not as a primitive type. In this respect his views coincide with those of Lameere, Boas and Handlirsch.

All entomologists will probably agree with Deegener that the characters peculiar to the larva have "arisen during metembryonic life successively in adaptation to differences in the conditions of the environment." He discusses at some length the reasons for the larval retardation in the development of the wings, and in this connection gives an interesting account of the subimago of the Ephemeridea, for the purpose of showing that an insect can actually undergo ecdysis after it has completely or almost completely developed its wings, but he does not emphasize the obvious fact that the wings of insects are organs primarily associated with the dissemination of the species, and, therefore, correlated ontogenetically with the maturation of the reproductive organs. The few larvæ that are pædogenetic (*Cecidomyia*) and the few beetles (*Pissodes,* Scolytidæ) that become imagines long before reproduction, though striking exceptions, can readily be explained as secondary adaptations. Attention is called to the reduction of the number of ecdyses and the manner in which pupation has become

associated with two of these in metabolic insects. The pupa of the Holometabola is regarded as being to a certain extent a phylogenetic stage, analogous to the subimago of the Ephemeridea, but as having developed its peculiarities (quiescence, unchanged external form and profound internal changes) in correlation with the structural differences that separate the larva from the imago. These differences are described as follows:

In the Hemimetabola the whole development appears as at first progressively imaginipetal (total habitus), later as temporarily and progressively imaginifugal (provisional organs), with ontogenetic adaptations, and finally as regressively imaginipetal (involution of the provisional organs). In the Holometabola, on the contrary, development is at first regressively imaginifugal (total habitus and imaginal organs), then progressively imaginifugal (development of provisional organs of first and second order) and finally (in the pupa) progressively (total habitus and imaginal discs) and regressively imaginipetal (involution of provisional organs). Hence the Holometabola are characterized in the metembryonic portion of their life cycle by a regressively imaginifugal type of development, which changes to the progressively imaginipetal type in the pupa. In other words: Whereas the continuously progressive development of the Hemimetabola is not interrupted and is only slightly affected by the formation of provisional organs, the progressive development of the Holometabola up to the imaginal stage suffers a long interruption (during the larval stage) and is not resumed till the transition to the first imaginal stage (the pupa), in order to attain, by passing through this, the definitive imaginal form.

Deegener, like many other students of insect metamorphosis, regards the pupa as a teleological development which enables the organism greatly to lengthen its larval life, and through the magnitude and intensity of the changes which it undergoes, to drop out or fail to recapitulate, a great number of phylogenetic stages and thus to pass directly into the adult condition. The development of such a pupal stage, he believes, has been facilitated by the ability, so frequently observed in insects, to fast for long periods of time. In this connection he might also have called attention to the adaptation of the pupal stage to tiding over unfavorable seasons (cold winters in temperate and boreal, dry seasons in tropical regions), as has been pointed out by Lubbock, Haacke, Handlirsch and others.

WILLIAM MORTON WHEELER

The Systematic Relationships of the Coccaceæ, with a Discussion of the Principles of Bacterial Classification. By CHARLES-EDWARD AMORY WINSLOW and ANNE ROGERS WINSLOW. New York, John Wiley & Sons. 1908.

The book before us is the completed results of work by these authors of which we have had preliminary information through articles in SCIENCE[1] and the *Journal of Infectious Diseases*.[2]

This work is by far the most important contribution to the purely scientific side of bacteriology which has appeared in a long time. It marks the beginning of a new era in bacteriological classification and nomenclature.

The systematic classification of the bacteria has always been extremely artificial and arbitrary. Outside of the three large morphological groups, the cocci, bacilli and spirilla, classification has probably never expressed natural relationships. However useful for purposes of identifying species artificial classification may be, it never reaches its highest function until it tells us more than whether a species has been previously described in the literature. It can never be really useful until it expresses for us the real position of the species in question in relation to other forms, and to some extent, at least, tells us the probable line of descent which the species has followed in its development from other forms. This is the ultimate goal which the classification of all living forms should seek.

A few attempts have been made to recognize certain "groups" among the bacteria, and undoubtedly some of these groups repre-

[1] "A Revision of the Coccaceæ," SCIENCE, N. S., XXI., 1905, 669.

[2] "A Statistical Study of Generic Characters in the Coccaceæ," Biological Studies by the Pupils of William Thompson Sedgwick, Boston, 1906; also *Journal of Infectious Diseases*, III., 1906, 485.